



Climate change mitigation efforts among transportation and manufacturing companies: The current state of efforts in Sweden according to available documentation

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ABSTRACT

Globally, transportation and manufacturing emit large amount of greenhouse gases that needs to be lowered for reaching agreed upon climate goals. In this context evidence of mitigation activities among eighty-five companies and their forty-five parent companies in these two polluting sectors were traced focusing on a country that has committed itself to leading the implementation of ambitious climate-mitigation goals worldwide. Documentation from the companies in the transportation and manufacturing sectors was scrutinized (yearly reports, homepages and sustainability reports, if available) for evidence of any mitigation efforts, including emissions reporting and reduction goals. The study's results found that two thirds of the companies seemed to have done nothing to mitigate climate change, while efforts in the remaining companies were modest at best; mitigation activities among the forty-five parent companies were only slightly more ambitious. The implications of these depressing findings are discussed in the light of possible caveats and the possibilities of new policy measures such as gender quotas in company boards. The conclusion is that the study's results most likely reflect reality in the studied sectors and that novel approaches and more sector oriented research is needed in the quest for a carbon-neutral society.

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1. Introduction

As society enhances its efforts to mitigate climate change, for example, by reducing greenhouse gases (GHG) emissions, new agreements and goals are being negotiated with high hopes for implementation. One example is the Paris agreement from 2015, part of which stated that “deep reductions in global emissions will be required” in order to pursue “efforts to limit the temperature increase to 1.5 °C above pre-industrial levels” (UNFCCC, 2015, pp. 1–2). The need to mitigate GHG emissions may also be seen in the newly agreed-upon sustainable development goals for 2030, in which goal 13 focuses on “urgent action to combat climate change and its impacts” (UN, 2016). According to the Intergovernmental Panel on Climate Change (IPCC, 2014, p. 8), GHG emissions from the

industrial and transportation sectors contribute to 31% and 14% of total global GHG emissions, respectively. CO₂ contributes to 76% of total global GHG emissions (IPCC, 2014).

The transportation sector is considered quite problematic, as emissions have continued to grow despite more efficient vehicles and new policies (Sims et al., 2014). Muratori et al. (2017) point out that CO₂ emissions from freight, for example, have grown with a correlation to GDP, and the evidence of near-term global decoupling is limited.

Concerning mitigation in the manufacturing sector, the conclusion in the latest assessment by the IPCC is as follows: “An absolute reduction in emissions from the industry sector will require deployment of a broad set of mitigation options beyond energy efficiency measures” (Fischelick et al., 2014, p. 739).

Efforts to curb emissions of greenhouse gases from the industrial and transportation sectors include a range of policies, with a few examples given below.

Regarding transportation, one insight is that existing vehicle

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stock and existing road and fuel supply infrastructure can lock in emission paths for decades (Shalizi and Lecocq, 2009) unless aggressive policy intervention is undertaken. Policies in the transportation sector could, for example, enhance the energy intensity of vehicles and substitute oil-based products with others produced from low GHG sources. Policies could also encourage more rail and water transport, as they are relatively energy efficient. Other policies could also encourage sourcing of localized products, thus avoiding the transport of some goods. However, this could eventually be unpopular among transportation companies because demand would decline. Increasing energy efficiency in vehicles depends on large investments by vehicle manufacturers, which may require strong incentives and regulatory policies (Sims et al., 2014). Examples of such policies are targets and standards that are sharpened over time and policies for increasing the turnover of the vehicle fleet (Trafikanalys, 2015). Examples of policies in practice at the European Union level are the regulatory policies for new heavy duty vehicles through the European emission regulations. However, these do not concern emissions of CO₂ specifically (EU, 2016a), but they include standards for CO₂ emission levels for new light duty vehicles in place (EU, 2016b). In the United States, where transportation alone produces a third of total US greenhouse gas emissions, policies such as vehicle efficiency standards and subsidies for alternative motor vehicles are preferred over taxes on CO₂ emissions, as it is considered politically risky (Morrow et al., 2010). In Saudi Arabia, where emissions from road transportation have been growing steadily, policies for vehicle efficiency, environmentally friendly fuels and the management of growing travel demands are needed (Rahman et al., 2017).

Concerning mitigation in the manufacturing sector, the options include fuel and feedstock switching, carbon dioxide capture and storage (CCS), material use efficiency, recycling and reuse, product service efficiency or demand reductions (ibid). Costs and lack of information are identified as the main barriers to change, and one conclusion is that no single policy can address the full range of mitigation measures that are available for industry (Fischedick et al., 2014). Tanaka (2011) found a range of policies being implemented by governments around the world for lowering industrial greenhouse gas emissions, including regulations, financial instruments, energy and carbon taxes. In Nigeria, for example, the evidence shows that regulatory measures are effective instruments for reducing emissions for some companies, while others respond better to soft instruments, such as voluntary commitments, eco-audits and eco-labels, and renewable energy subsidies (Sanni, 2018).

In the quest for finding solutions for lowering emissions of greenhouse gases, Sweden provides an interesting case, as the Swedish prime minister (Government Offices of Sweden, 2016a) declared that Sweden will take a leading role in implementing the new Sustainable Development Goals (Government Offices of Sweden, 2016b). According to the same source, Sweden has a good point of departure for succeeding in its implementation of the sustainability goals; Sweden will prepare an action plan and will serve as a good example of how all aspects of sustainability (i.e., economic, environmental and social) can be supported (ibid). Based on this evidence, Sweden appears to be at the forefront for implementing global climate-related goals, and whatever lessons can be learnt here can be relevant in other countries as well. Official CO₂ emissions statistics from Sweden show that industry dominates the nation's total emissions, with 81%; out of that 81%, the transportation sector emits 29%, while the manufacturing sector emits 35% (Statistics Sweden, 2016a,b). Climate change mitigation efforts in the two latter sectors would thus appear to be crucial for success if Sweden wishes to succeed in leading sustainable development efforts.

With the above in mind, efforts to mitigate climate change among companies in Sweden's most polluting sectors using publicly available documents, such as yearly reports, sustainability reports (when available) and companies' home pages, were investigated. The assumption was that studying such documents would provide an indication of the extent to which mitigation through the reduction of CO₂ emissions is on the agenda among companies today and that this method would provide relevant results and complement other methods, which will be carried out at a later stage, such as interviews and surveys about reasons for mitigation or not. Here, the results from the documentation study are presented along with the research question:

To what extent is climate change mitigation on the agenda in companies in the most CO₂-polluting sectors in Sweden (transport and manufacturing), given that this country considers itself in the forefront of mitigating climate change?

2. Method

Using national statistics (Statistics Sweden, 2016a,b), the most polluting subsectors within the transportation and manufacturing sectors were identified (see Table 1), and these subsectors were numbered according to two-digit NACE levels (for "Nomenclature générale des activités économiques dans les Communautés Européennes," or "General Industrial Classification of Economic Activities within the European Communities"). The main emissions (more than 20% of the total) in the transportation sector came from "50: Water transport" (48%), "49: Land transport and transport via pipelines (27%)" and "51: Air transport" (22%). Together, these subsectors contribute 97% of the total emissions of CO₂ in the transportation sector in Sweden. The main emissions (more than 20% of the total) within the manufacturing sector came from "24: Manufacture of basic metals" (29%), "23: Manufacture of other non-metallic mineral products" (29%) and "19: Manufacture of coke and refined petroleum products" (24%). Together, these subsectors constitute 74% of total CO₂ emissions within the Swedish manufacturing sector.

Statistics Sweden provided a list of all companies in the selected subsectors with more than 10 employees. The choice to exclude companies with fewer than 10 employees was based on the assumption that small companies would have fewer opportunities to engage in policies and actions to mitigate emissions. The request resulted in a list of 2515 companies; using these companies' respective corporate identity numbers, the Swedish Companies Registration Office provided information about the number of board members per company. Using this list, all companies with at least five board members were selected. This resulted in a list of 256 companies that was then sorted according to turnover; the results

Table 1

The most-polluting (via CO₂ emissions) subsectors within the Transportation and Manufacturing sectors in Sweden 2012 (Statistics Sweden, 2016a,b).

Main sector	Subsector NACE level ^a	Explanation
Manufacturing	19	Manufacture of coke and refined petroleum products
	23	Manufacture of other non-metallic mineral products
	24	Manufacture of basic metals
Transportation	49	Land transport and transport via pipelines
	50	Water transport
	51	Air transport

^a The two-digit numbers are as per NACE 2007 (European Commission, 2016a,b,c).

ranged from 5 to 10 million SEK to more than 1 billion SEK (0.54–1.1 million Euro and more than 109 billion Euro, respectively). Although none of these companies were publicly listed ([Nasdaq Nordic, 2016](#)), four were publicly owned. The selection of companies with at least five board members was based on the assumption that when few people are on the board, fewer opportunities arise to engage board members with “non-traditional” competences, such as environmental and climate-related competences. According to [de Villiers et al. \(2011\)](#), the likelihood is greater among larger boards that some directors will have been exposed to the impacts of an environmental agenda.

Every third of the 256 companies (85 companies) was selected, since it was decided that this was the best way of achieving an unbiased selection. Of course, this could have been achieved in other ways (e.g., having a computer randomly choosing companies), but there was no reason to expect the companies to be biased by the alphabetical order of their names. After this selection, the company's most recent yearly reports, as submitted to the Swedish Companies Registration Office, were scrutinized. Submitting such reports every year is required by law ([Swedish Government, 1995](#)). We also analyzed the selected companies' home pages, as well as their sustainability or environmental reports (if available). To obtain the two types of reports, every company was contacted via the contact addresses listed on their home pages. The investigation was carried out during autumn 2015 and spring 2016. For all companies with a parent company that owned at least 51% of its shares (45 companies), documentation from the parent companies was scrutinized as well. The criteria for analysis related to climate change mitigation for all documents, which were inspired by the criteria used by [Folksam \(2013\)](#), were as follows:

- 1 Is climate, CO₂ or global warming mentioned? Yes/No
- 2 Is there a quantified goal for GHG/CO₂ emissions? Yes/No
- 3 Is there a quantified goal for energy use? Yes/No
- 4 Is there a quantified goal for renewable energy? Yes/No
- 5 Are climate-related demands put in place for subcontractors? Yes/No
- 6 Are GHG/CO₂ emissions reported? Yes/No
- 7 Is energy use reported? Yes/No
- 8 Are indirect GHG/CO₂ emissions reported? Yes/No

- 9 Have the resulting GHG/CO₂ emissions and energy-use reports been verified by a third party? Yes/No

Whether or not the yearly reports and the home pages mentioned “environment” (Yes/No) was also checked, excluding any mentions that only had to do with adherence to regulations in the Swedish Environmental Code ([Government Offices of Sweden, 2000](#)) and any mentions that only dealt with the work environment. If an environmental management system had been implemented, it was noted, along with whether the company had a parent company; if so, documents related to the parent company were checked.

“Yes” answers to all climate-related questions were given 2 points, except for question 1 (mentioning climate, etc.), which was given only 1 point. It was thus possible for a company to obtain at most 17 climate-related points for each document (yearly report, home page and sustainability report) and 51 points when all the documentation was considered.

After compiling the results from the investigation above, two workshops with persons with substantial board experience and/or experience in research about companies' environmental performance were convened. These workshops were held in January and March 2016. Here, the results were discussed (see further below).

For this study, the interest was to get an overview of which — if any — actions had been taken by the companies to mitigate climate change — not what these actions meant in terms of actual reduction. Even if the material did, for example, give an indication of whether the use of renewable energy was quantified or not, no analysis of actual impact on climate emissions was performed, as this was not the focus of the study. In fact, such an analysis would be quite substantial and require cooperation with the polluting companies to gather enough data about the level of renewable energy and the types.

3. Results

Within the 85 companies that were studied, the overall average climate score was 0.73 points out of a possible 51 points. The distribution of points across companies is shown in [Fig. 1](#). Roughly two-thirds of the companies (67%) failed to achieve any climate

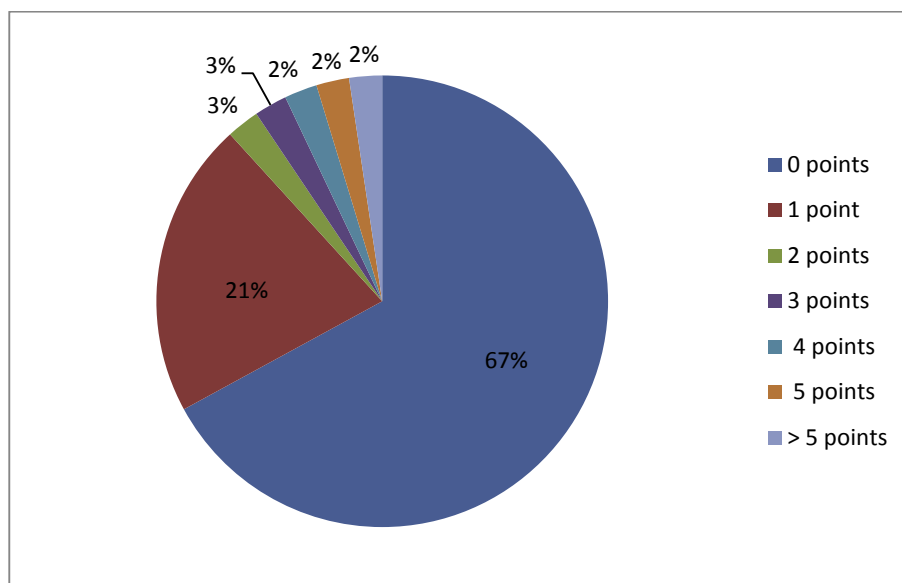


Fig. 1. Total climate scores for 85 companies in the Swedish transportation and manufacturing sectors (total score of 17 possible).

Table 2

Climate points from different documents among 85 companies in the Swedish transportation and manufacturing sectors, as well as climate points among the 45 parent companies.

	Average number of climate points		
	Yearly reports	Sustainability reports	Homepages
Companies (N = 85)	0.26 (N = 85)	2 (N = 2)	0.53 (N = 67)
Parent companies (N = 45)	1.5 (N = 45)	7.4 (N = 9)	1.6 (N = 37)

points at all, and 21% received only 1 point. The highest score was 10 points (achieved by one company), and the next highest was 6 points (also one company).

The distribution of points according to the different documents that were studied is shown in Table 2. Only two out of the 85 companies were found to have sustainability or environmental reports; among these two, the average score was 2. The average score was 0.53 among the 67 home pages found. Thus no, substantial difference in points among the three types of documents studied was found, and the scores were quite low compared to the maximum amount of points (17) that could have been obtained for each document (Table 2).

When looking at documentation from 45 parent companies (Table 2), the average total climate score was 4.1, which was significantly higher than among the 85 companies that were studied (0.73). However, compared to the maximum number of points that could be gotten the variation between these parent companies was enormous, however, with a range from 0 to 23 points. Out of the four parent companies with more than 15 points, two were located outside of Sweden. Among the parent companies, climate change was mostly mentioned in the sustainability reports.

For the mention of “environment,” however, the picture was different—47% of the 85 companies mentioned the environment in their yearly reports, while 67% did the same on their home pages. Some of the mentions of the environment had to do with the companies’ certification with standards such as ISO 1400:1, which is a management system that provides tools for companies to manage their environmental responsibilities (ISO, 2016). Other companies mentioned that their vehicle fleets were conservatively driven and that they used biofuels whenever possible, while other mentions of the environment were quite vague. Although the way in which “environment” was contextualized varied considerably, these uses were not further analyzed here. Among the 45 parent companies, “environment” was mentioned in 64% of the yearly reports, and it was mentioned on their home pages in 78% of the cases.

The correlation between company size (measured as turnover in the 85 companies) and climate points in the annual reports is 0.32, which indicates a positive correlation. The differences between companies with and without parent companies were small: the former’s average total climate score was 0.78 points, while the latter’s was 0.70 points.

4. Discussion

The studied available documentation from 85 randomly selected companies in the most CO₂-polluting sectors in Sweden (the manufacturing and transportation sectors), a country which considers itself in the forefront of mitigating climate change, shows that two-thirds of these companies did not appear to carry out any substantial climate change mitigation work at all, while mitigation efforts in the other one-third were quite low. This is obviously a very discouraging result, given that climate change and the need for

mitigation has been on the agenda since the 1990s and given that good examples of mitigation activities urgently need to be found, communicated and implemented in forerunners as Sweden. At first glance, the results call for action and further research.

However, some potential caveats in the method used in this study were discussed during the two seminars that were held with experts from the corporate world and from the industry-related research community in 2016. At those workshops, the experts’ opinions about whether our depressing results could be trusted were sought. The following section reports on the issues brought up during the two workshops, after which the various reasons for the low activity and some possible policies for change are discussed.

4.1. Could mitigation activities not be reflected in the documents we studied?

Faced with the bleak climate change mitigation efforts that our study indicated, our seminar participants were asked whether it was possible that a company could actively work on climate change mitigation efforts without indicating this in their yearly reports or on their home pages. The discussions went in two directions: one was that companies may be reluctant to publicize their mitigation efforts out of fear of media exposure and criticism for not having done enough in the past. The idea of “greenwashing” (e.g., Bowen et al., 2014) was also discussed, with the implication that some companies might have mentioned climate and climate goals in their documentation despite not taking any actual actions. All of the experts who we consulted with agreed, however, that our results about poor climate change mitigation performance were plausible and that this poor performance was not surprising.

The fact that quite a few companies used environmental management systems such as ISO 1400:1 was also discussed, with inconclusive results of what this means for climate mitigation work. Coglianese and Nash (2002) pointed out that to comply with ISO 1400:1, a firm needs to commit itself only to making improvements in environmental management — but not to striving to meet ambitious goals. Nawrocka and Parker (2009) referred to numerous studies that showed how the implementation of ISO 1400:1 has affected companies’ environmental performance; the authors found that the results of these studies were inconclusive.

In summary, the seminar participants confirmed that the depressing findings presented above were realistic, and given that this is the situation in a very climate ambitious country, it does not bode well for the global mitigation efforts needed to achieve the needed deep reductions in global emissions (UNFCCC, 2015).

4.2. Reasons for inaction and possible policies for change

The fact that many companies mentioned “environment” but not “climate” in their documents merits further attention. Several factors might explain why companies might mention the environment without indicating that they are carrying out actions in any way to mitigate climate change. One may be related to the fact that the environment has been a mainstream issue since the 1960s, while climate change first emerged on the public agenda in the mid-to-late 1980s (Moser, 2010). As the same author points out, however, the reasons for not acting on climate change may also be related to the challenges in communicating the importance of mitigating climate change, as opposed to the importance of waste management, for example. According to Moser (2010), communicating climate change may be challenging for several reasons, including the invisibility of causes, distant impacts, lack of immediacy and direct experience with the impacts, lack of gratification for taking mitigative actions, disbelief in humans’ global influence,

general complexity and uncertainty, inadequate signals that indicate the need for change, perceptual limits and self-interest. According to Weber (2016), rule-based decisions that determine behavior based on social responsibility and moral principles seem to have the best prospects for appropriate actions. Weber also states that an ideological polarization has occurred on climate change perceptions and that a gender and age difference exists: men and older people are more skeptical than women and young people (*ibid*). Further, MacCright and Dunlap (2011) have shown that conservative white men are more skeptical about climate change than other men. Several authors have shown that disbelief in climate change leads to the lack of adaptation measures being taken within the forestry and municipal sectors (Blennow and Persson, 2009; Carlsson Kanyama and Hörnsten Friberg, 2012), and some evidence suggests a connection between gender and an interest in climate issues (Davidson and Freudenberg, 1996; Braun, 2010), as women display stronger environmental attitudes, express a higher risk perception about climate change and demonstrate a higher willingness than men to change their behavior, even when it comes to personal sacrifices to try to mitigate climate change (Braun, 2010).

Although the Swedish government (and most governments in general) cannot influence the ideology or the age of companies' boards and leadership, the Swedish government could change the gender balance of companies' boards through legislation. Several European countries, including Norway, Spain, Iceland, France, Belgium, the Netherlands, Italy and Germany, have implemented laws on gender quotas in company boards, but the Swedish government has thus far not legislated a minimum share of women on boards. Gender quotas have not been discussed as a tool for enhancing mitigation activities in companies yet, and it is unclear if it would have an impact on a company's focus on climate change. A few researchers have examined the associations between gender-mixed boards and companies' environmental strategies. Rao and Tilt (2016) reviewed the existing literature on the relationship between corporate governance (particularly board diversity) and corporate social responsibility (CSR), which includes environmental concerns, to determine how gender-mixed boards affect strategic decision-making processes. Examining intermediate variables rather than direct relationships would likely provide more knowledge on how gender diversity affects companies' strategic decisions (Nielsen and Huse, 2010; Rao and Tilt, 2016). Given the urgency of mitigation, this track could be followed more in depth through research on companies where women are underrepresented, which is most of them (Catalyst, 2018).

Some other current policies in Sweden, such as legislation for compulsory sustainability reports for companies with more than 250 employees (Department of Justice, 2016), could raise expectations for increasing mitigation activities among polluting companies. But in the sectors examined for the current study, such companies are few in number: fewer than 2% of the total number (SCB, 2016a,b). The fact that a company has a sustainability report, however, does not guarantee that ambitious targets for climate change mitigation will be realized. Also, Hubbard (2011) concluded that sustainability reports from the large companies that currently issue them lack clear policies and targets for performance and present many examples of greenwashing.

Some other policies that could be implemented but are currently lacking in Sweden (Trafikanalys, 2015) include increasing the turnover of the vehicle fleet (currently 16 years old) and skipping the current exemption on energy taxes on electricity in the Swedish manufacturing sector (Swedish Tax Authorities, 2016), but such measures are politically controversial. Some of our studied companies in the manufacturing sector are probably part of the EU Emissions Trading Scheme (EU, 2016a,b,c), but as this scheme only

includes larger companies, its impacts on the whole sector must be low in Sweden.

In summary, the Swedish government claims to be in the forefront of climate change mitigation and has implemented a high carbon tax, but it clearly faces several hurdles in translating ambitious goals for climate change mitigation into action within the Swedish transportation and manufacturing sectors. More research is needed to understand how smaller companies can take part in transitioning to a low-carbon society, and such research should encompass companies in a range of countries.

5. Conclusions

The results from the present study — which focused on the state of mitigation efforts among companies in the two most polluting sectors in a country that claims to be in the forefront of climate change mitigation — are not encouraging, as mitigation efforts in those companies appear to be weak, with two-thirds of them not mentioning climate or climate goals at all in their publicly available documents. This information is new and needs to be considered in the policy research community, with implications for the hopes to keep global warming under 2 °C. Further inventive research is needed to develop policy measures that are suitable for small to medium-sized companies as well as methods for following up the results of measures taken. In the latter quest, the method used here, which was to collect data about mitigation efforts through scanning companies publicly available documents, is one relatively easy way of getting information about trends and status when it comes to mitigation efforts in polluting companies and we recommend its further use.

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